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# NRC Plan for Cleanup Operations at Three Mile Island Unit 2

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TMI Program Office

**Office of Nuclear Reactor Regulation  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555**



MEMORANDUM FOR THE RECORD

On 10/10/54, the following information was received from the [illegible] office:

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## ABSTRACT

This report updates a plan that defines NRC's role in cleanup operations at Three Mile Island Unit 2 (TMI-2) and outlines NRC's regulatory responsibilities in fulfilling this role. These responsibilities include reviewing and approving General Public Utilities Nuclear Corporation (the licensee) proposals for cleanup actions, overseeing the licensee's implementation of approved activities, coordinating with other Federal and state governmental agencies on their activities in the cleanup, and informing local officials and the public about the status of the cleanup.

Since the initial issuance of this NRC Plan in July 1980, this office has issued the Final NRC Programmatic Environmental Impact Statement (PEIS) related to the entire TMI-2 cleanup and a draft Supplement to the PEIS related to occupational radiation exposure. Additionally, a number of developments have occurred which will have an impact on the course of cleanup operations. This revision provides a discussion of these developments, specifically in the areas of the functional role of the NRC in cleanup operations, the cleanup schedule, and the current status of the cleanup. The plan also discusses NRC's perceived role in future cleanup activities. Because of major uncertainties in the funding of the cleanup, portions of this plan, including the estimated schedule, are likely to require further changes as availability of funding and other factors affect the pace of the cleanup.



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## ABBREVIATIONS

AFHB	Auxiliary and Fuel Handling Building
ALARA	As Low as Reasonably Achievable
CEQ	President's Council on Environmental Quality
CFR	Code of Federal Regulations
CY	Calendar Year
DOE	United States Department of Energy
DOT	United States Department of Transportation
EPA	United States Environmental Protection Agency
EPICOR-II	A demineralizer system that combines filtration with ion exchange. This system is designed to process intermediate level liquid waste.
GPUNC	General Public Utilities Nuclear Corporation
IE	NRC Office of Inspection and Enforcement
NMSS	NRC Office of Nuclear Materials Safety and Safeguards
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NRC	United States Nuclear Regulatory Commission
NRR	NRC Office of Nuclear Reactor Regulation
OELD	NRC Office of the Executive Legal Director
PEIS	Programmatic Environmental Impact Statement
RES	NRC Office of Nuclear Regulatory Research
RCS	Reactor Coolant System
RPV	Reactor Pressure Vessel
RPVH	Reactor Pressure Vessel Head
SDS	Submerged Demineralizer System, a demineralizer system that combines filtration with ion exchange. This system is designed to process high level liquid waste.
TAAG	Technical Advisory and Assistance Group
TMIP0	Three Mile Island Program Office
TMI-2	Three Mile Island Nuclear Generating Station Unit 2

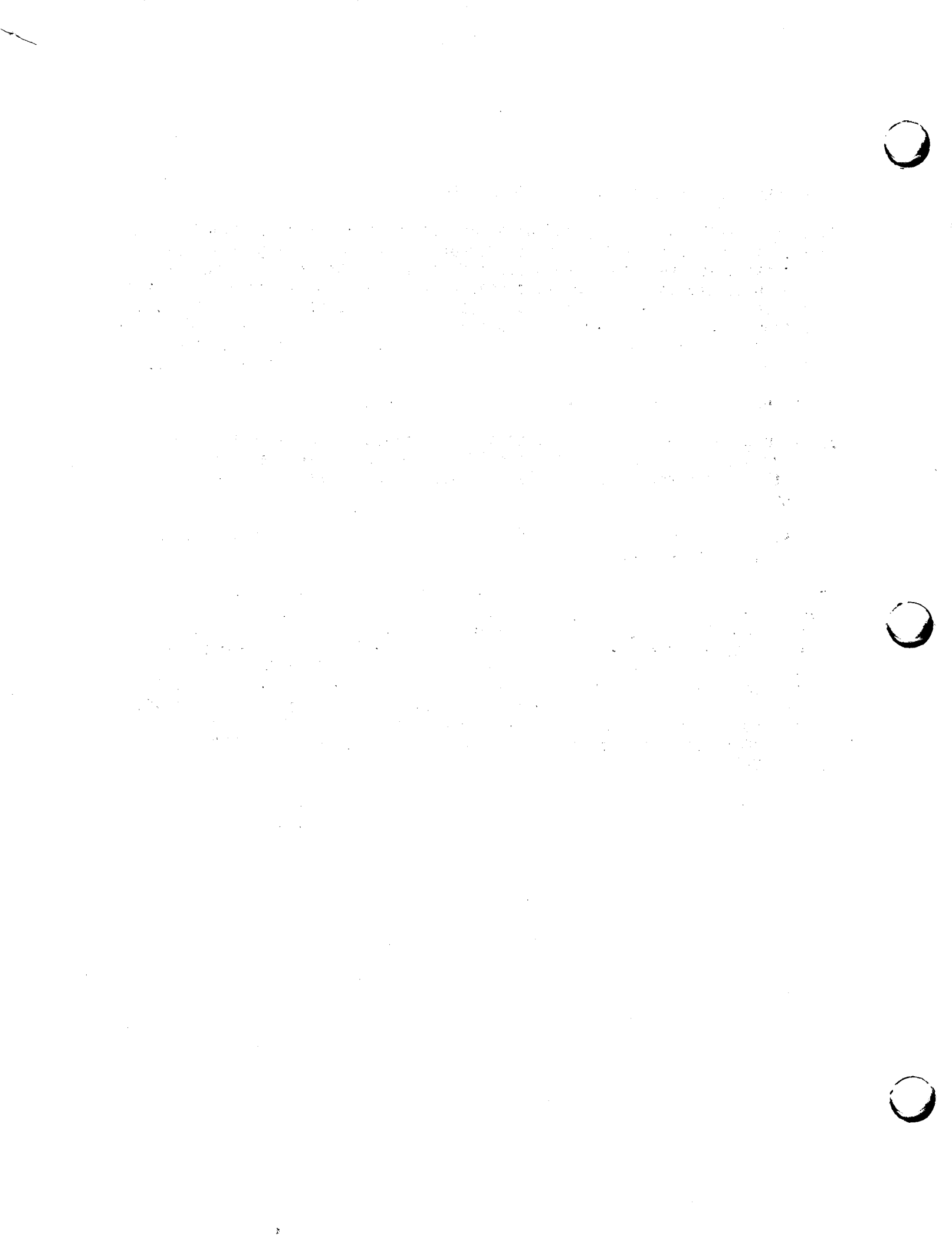




## 1 THE PURPOSE AND SCOPE

The purpose of this NRC plan is to (1) define the functional role of the NRC in cleanup operations at Three Mile Island Unit 2 to assure that agency regulatory responsibilities and objectives will be fulfilled; (2) provide a general schedule of major cleanup actions and the NRC's role in meeting these milestones; and (3) provide an update of the cleanup progress to date. The plan outlines NRC functions in the following areas: (1) the relationship of NRC to other government agencies, the public, and the licensee for the coordination of activities, (2) the NRC review and decision-making process for the licensee's proposed cleanup activities, and (3) NRC's role in overseeing implementation of approved licensee activities.

NRC inspection functions at the site are carried out by Office of Inspection and Enforcement personnel under the direction of the onsite Three Mile Island Program Office and are not described in detail in this plan.



## 2 THE NRC OBJECTIVES IN TMI-2 CLEANUP OPERATIONS

The safe expeditious cleanup and decontamination of Three Mile Island Unit 2 (TMI-2), including removal of the fuel from the accident-damaged reactor, are necessary for the long-term protection of public health and safety as well as to ensure that the TMI site does not become a long-term or permanent waste repository. The NRC is responsible for the regulation of TMI-2 cleanup operations to assure the health and safety of the public and the TMI-2 occupational workforce and the protection of the environment. For all post-accident operations at TMI-2, NRC has maintained the following regulatory objectives:

- (a) Maintain reactor safety and control of radioactivity,
- (b) Assure that environmental impacts are minimized, and that radiation exposures to workers, to the public, and to the environment are within regulatory limits and are as low as reasonably achievable, and
- (c) Assure interim safe storage and/or disposal of radioactive wastes from cleanup operations.

Implementation of cleanup activities is the responsibility of the licensee, General Public Utilities Nuclear Corporation. However, should the licensee and its parent company go bankrupt or otherwise default on its obligation to decontaminate the TMI-2 facility, NRC's role in decontamination operations may change. Nevertheless, NRC objectives in TMI-2 cleanup operations will remain the same: to protect public health, safety, and the environment. The NRC staff has prepared a contingency study of NRC actions required should the licensee be unable to finance the TMI-2 cleanup, entitled "Potential Impact of Licensee Default on Cleanup of TMI-2" (NUREG-0689).



### 3 NRC FUNCTIONS

The TMI Program Office (TMIPO) was established within the NRC Office of Nuclear Reactor Regulation (NRR) to provide overall direction of Three Mile Island Unit 2 (TMI-2) cleanup operations. The TMIPO has the following regulatory responsibilities.

- (1) Planning and managing all NRC involvement in TMI-2 cleanup activities,
- (2) Obtaining information and evaluating current facility status,
- (3) Analyzing and reviewing the licensee's proposed actions and procedures,
- (4) Preparing technical review documents on the safety and environmental impacts of licensee-proposed cleanup actions,
- (5) Approving or disapproving the licensee's proposed actions and procedures,
- (6) Advising the Commission on major cleanup actions,
- (7) Coordinating NRC's TMI-2 cleanup activities with other governmental agencies as necessary,
- (8) Informing State and local governments and the public on the status and plans for cleanup activities,
- (9) Overseeing day-to-day licensee activities to ensure that operations are implemented in accordance with the facility's operating license and relevant orders and plans,
- (10) Ensuring activities are carried out in compliance with approved NRC limits and procedures, and
- (11) Coordinating with the NRC Office of Inspection and Enforcement on its TMI-2 inspection activities.

To perform these functions, the TMIPO has established a staff with management and technical expertise in key TMI-2 cleanup activities, such as radiation protection, radiological assessment, radwaste treatment, and nuclear safety. Support by experts in other disciplines is available from other NRC staff and, under arrangement with the National Laboratories. Contractors and consultants provide technical assistance when the TMIPO determines it to be necessary. The TMIPO also coordinates its activities with the licensee, other Federal agencies, State and local government officials, and the public. Figure 3.1 identifies the major functions of these organizations and provides an overview of their functional relationship.

#### 3.1 Support Functions

The TMIPO may request that NRC program offices provide specialized technical support in the following areas: NRR for ecology, hydrology,

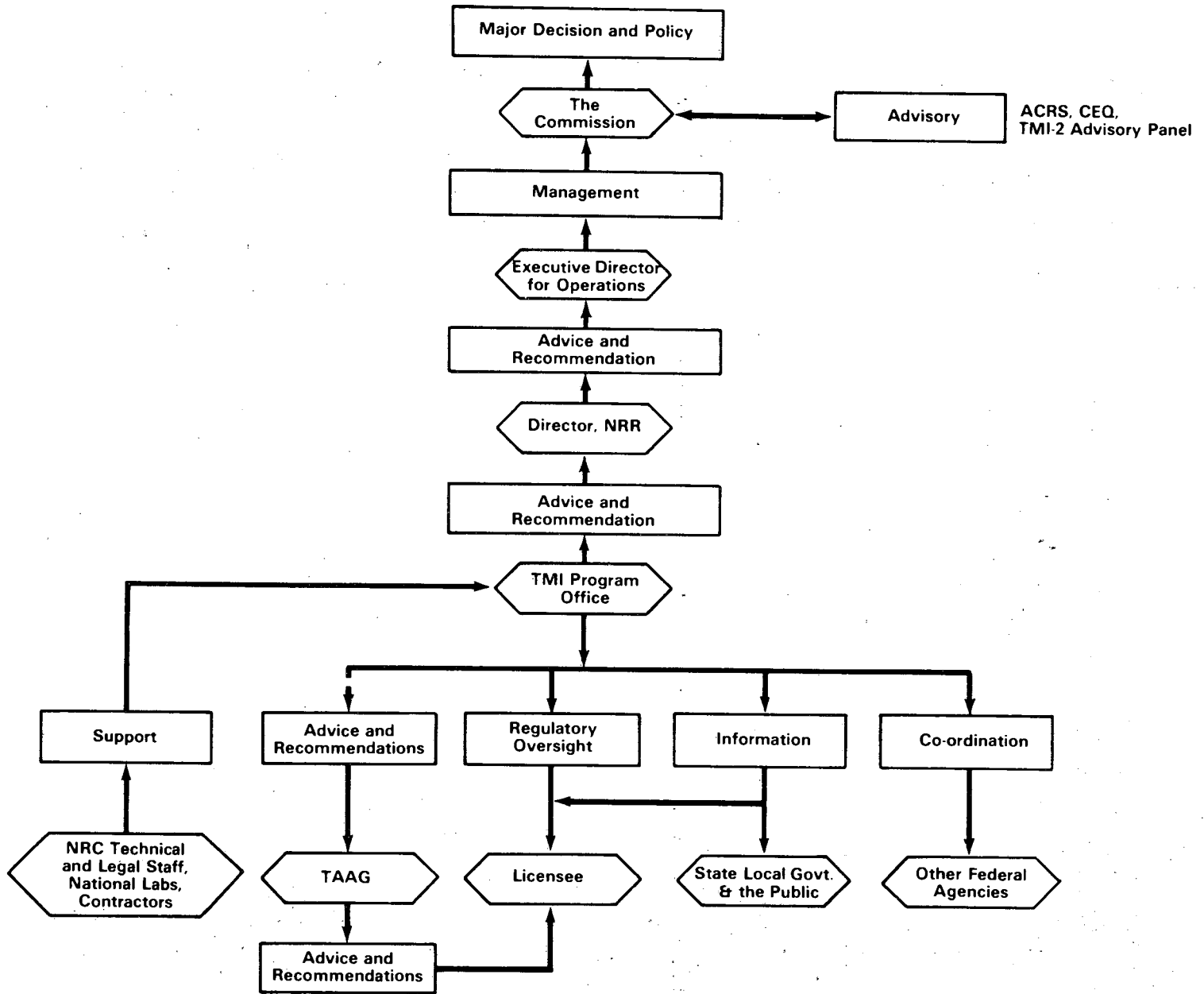


Figure 3.1 Major NRC Functional Roles in TMI-2 Cleanup Operations

meteorology, geology, reactor core analysis, radiological assessment and instrumentation and control systems; the Office of Nuclear Material Safety and Safeguards (NMSS) in processing, transportation, disposal and/or storage of radioactive waste; the Office of the Executive Legal Director (OELD) for legal advice; the Office of Inspection and Enforcement (IE) for special inspections of licensee activities; and the Office of Nuclear Regulatory Research (RES) in support for any needed research programs.

The TMIPO also obtains technical support from organizations such as National Laboratories and other contractors or consultants. These support tasks are managed by the TMIPO.

### 3.2 Coordination Functions

The TMIPO coordinates NRC functions with several other Federal agencies that are participating in cleanup operations. On July 15, 1981 (revised March 15, 1982) a Memorandum of Understanding (MOU) was signed by the NRC and the Department of Energy (DOE) which formalized the working relationship between the two agencies with respect to the removal and disposition of radioactive wastes generated during the cleanup of TMI-2 (Appendix A). The memorandum addresses the following three basic categories of TMI-2 wastes:

- (1) Wastes determined by DOE to be of generic value in terms of beneficial information to be obtained from further research and development (R&D) activities. The MOU calls for DOE to perform such R&D activities at appropriate DOE facilities.
- (2) Wastes determined to be unsuitable for commercial land disposal due to high levels of contamination, but which DOE may remove, store and dispose of on a reimbursable basis from the licensee, and
- (3) Low-level wastes which are to be disposed of by the licensee in licensed, commercial low-level burial facilities.

The MOU specifically highlights currently identified TMI-2 wastes, e.g., EPICOR-II (a demineralizer system) wastes, Submerged Demineralizer System wastes, and reactor fuel wastes. The MOU also covers wastes which may be generated as the cleanup progresses.

The U.S. Environmental Protection Agency (EPA) is participating as the lead agency for offsite environmental monitoring programs, and, as appropriate, the President's Council on Environmental Quality (CEQ) has been advising the NRC on its National Environmental Policy Act (NEPA) responsibilities. The TMIPO also coordinates with the Commonwealth of Pennsylvania, the State of Maryland, and local government officials on TMI-2 cleanup activities.

A TMI-2 technical advisory and assistance group (TAAG) has been established to provide independent technical assessment and advice on the decontamination and defueling of TMI-2. This group assures that approaches to the various cleanup and defueling operations are technically adequate and that consideration has been given to maintaining radiation exposures as low as reasonably achievable (ALARA). The TAAG consists of approximately 10 permanent members and additional ad hoc members where special expertise is needed. The group responds to specific requests from any of the three parties: the licensee, the NRC-TMIPO, or DOE.

A TMI Information and Examination Program has been established to acquire data which could significantly improve current understanding of nuclear plant accident environments and the phenomena which contribute to those environments. The licensee, the Electric Power Research Institute, the NRC, and the DOE, through DOE's prime contractor at TMI-2, EG&G, Idaho, Inc., jointly sponsor and participate in this program. In addition to the participation of NRC in the technical working group for this program, the NRC reviews the data acquisition tasks of the program to ensure that these tasks are implemented in coordination with ongoing cleanup activities, and to the maximum possible extent, utilizes these tasks and the data acquired for the benefit of the cleanup.

### 3.3 Information Functions

The TMIPO has taken on the responsibility of keeping State and local government officials and the public informed on a continuing basis of the progress and the status of cleanup operations, as well as of future plans. This function is performed both by the TMIPO headquarters and onsite staff and by the TMIPO Field Office personnel in Middletown, PA. These offices disseminate information (for example, the weekly plant status report on the cleanup) routinely to local officials and the public. Additionally, the staff conducts public meetings and gives interviews with the media to keep the public and local officials informed of the status and specific aspects of the cleanup effort.

### 3.4 Advice and Recommendation Functions

Licensee-proposed cleanup operations may require the approval of the Commission if the estimated environmental impacts exceed those given in the Programmatic Environmental Impact Statement (PEIS). Towards this end, the TMIPO keeps the Commission informed as to the current status of cleanup operations and planning. To facilitate Commission decision making for those proposals which require Commission approval, the TMIPO will develop recommendations based on its review and evaluation of the licensee's proposed cleanup plans. The TMIPO will also inform the Commission when staff actions are taken on significant cleanup activities which the staff is authorized to approve. In addition, the TMIPO provides periodic reports to the Commission on the status of the cleanup and future plans.

In 1980, the NRC established a 12-member TMI-2 Advisory Panel to consult with and provide advice to the Commission on major activities related to the decontamination and cleanup of TMI-2. The panel consists of members from the Commonwealth of Pennsylvania, local government, and the scientific community, as well as the public in the vicinity of TMI. The TMIPO provides liaison between the Commission and the TMI-2 Advisory Panel and also provides information to the panel on the status of the cleanup.

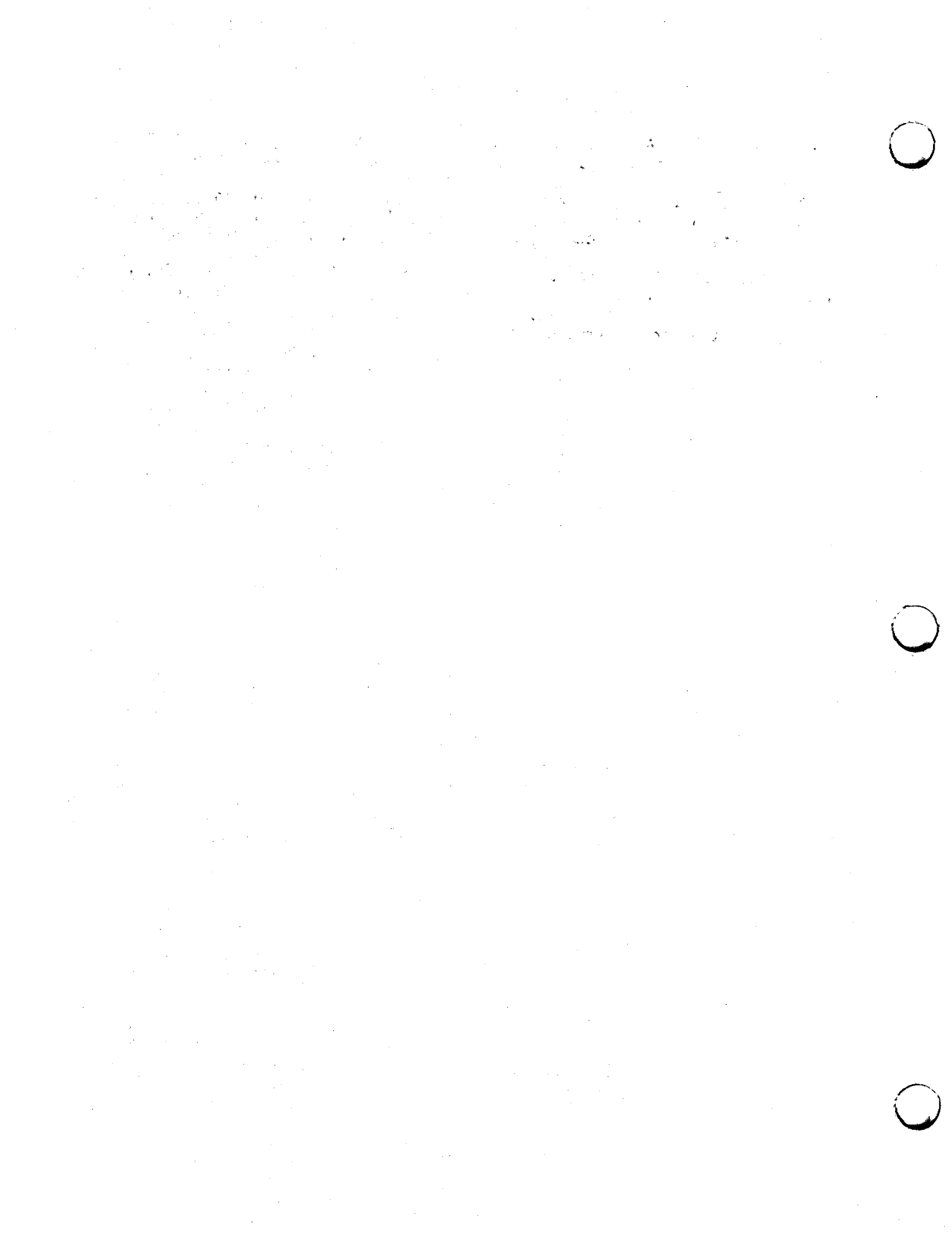
### 3.5 Regulatory Oversight Functions

NRC maintains regulatory oversight of the licensee's cleanup activities. In general, this function is accomplished in three phases: (1) long-term planning, (2) review and approval of proposed cleanup activities prior to their implementation, and (3) oversight of day-to-day operations. The NRC maintains cognizance of the licensee's long-term planning to assure that the licensee's



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cleanup objectives are consistent with those of the NRC in maintaining the health and safety of the public and workers, and minimizing environmental impacts. Day-to-day oversight by the TMIPO onsite staff provides assurance that activities are implemented according to approved plans and assures compliance with existing NRC regulations, the facility's operating license, technical specification requirements, and approved procedures.

For certain activities, written procedures proposed by the licensee will require TMIPO review and approval. As part of the TMI-2 License, Section 6.8 of the Technical Specifications for TMI-2 details the type of activities and requirements on written procedures. (Section 6.8 is reproduced in Appendix B.)



## 4 NRC REVIEW AND DECISION-MAKING PROCEDURE

NRC review and approval are required prior to the implementation of major cleanup operations by the licensee. Each cleanup activity proposed by the licensee will be reviewed by the TMIPO to assure that all applicable NRC requirements are met to protect the public's health and safety and minimize worker exposure. To the extent applicable, such review will draw upon the evaluation of the cleanup alternatives discussed in the "Programmatic Environmental Impact Statement Related to the Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident at Three Mile Island Nuclear Plant (PEIS) (NUREG-0683)<sup>2</sup>, and any supplements to the PEIS, and will focus on the safety and environmental impacts of the proposed activity.

In its Policy Statement<sup>3</sup> accompanying the PEIS, the Commission directed the staff to determine whether specific licensee cleanup proposals and the associated potential impacts fall within the scope of those already assessed in the PEIS. If the proposed actions are within the PEIS scope and any supplements, the Director, TMIPO, has been delegated the approval authority, while keeping the Commission informed of the staff's actions on each major proposal. If the licensee's proposal is not within the PEIS scope, the Commission is notified and additional reviews by the TMIPO staff are undertaken in accordance with the National Environmental Policy Act (NEPA). The staff, based on an environmental and safety review, makes a recommendation on the proposed action to the Commission.

At any time, if the staff determines that the conclusions presented in the PEIS have substantially changed, then the staff will issue a supplement revising the PEIS in accordance with NEPA. Such a determination has been made for the estimates of occupational radiation exposure, and a draft Supplement<sup>4</sup> was issued for public comment in January 1984.

### 4.1 Proposals From the Licensee

NRC will independently review the licensee's proposed actions and, consistent with NRC responsibilities, ensure that public and worker health and safety and the environment will be adequately protected. In order to expedite the implementation of licensee activities, it is imperative that the licensee provide timely and complete information on proposed actions to enable the TMIPO staff to conduct safety and environmental reviews.

### 4.2 The NRC Review Process

The TMIPO has access to sufficient technical expertise to review, evaluate, and determine the adequacy of TMI-2 cleanup actions proposed by the licensee. All such proposals will be reviewed by TMIPO to determine whether the action can be undertaken with reasonable assurance that it will not endanger the health and safety of the public and workers and is environmentally acceptable. Licensee-proposed cleanup actions fall within two categories: those requiring amendments to the license and those that do not.

- (1) If the proposed action involves a request for a license amendment, the TMIPO staff first determines if it is within the scope of the PEIS. A proposed cleanup activity is considered within the scope of the PEIS if the following conditions are satisfied:
  - a. It is similar to the general type of activities discussed in the PEIS for the cleanup and/or disposal of radioactive wastes from the TMI facility.
  - b. Its potential environmental impacts are not significantly different (qualitatively and quantitatively) from those environmental impacts assessed in the PEIS.

If the TMIPO determines any major activity and its predicted environmental impacts fall outside the scope of those already assessed in the PEIS, the Commission will be informed and the TMIPO staff will complete necessary reviews in accordance with the NEPA and NRC requirements. If the staff determines that a supplement to the PEIS is appropriate, the supplemental environmental statement will be prepared under the direction of the TMIPO. In the event a proposed activity falls outside of the scope of the PEIS, but does not require the preparation of a supplemental environmental impact statement, the TMIPO staff will publish a negative declaration to that effect and provide an Environmental Impact Appraisal in support of the negative declaration.

Figure 4.1 illustrates the NRC review process for preparing supplements to the PEIS. The public can review draft supplements to the PEIS during a defined comment period. Other government agencies having an interest in the review, monitoring, and in some cases, participation in some phases of the proposed cleanup operation, will be involved in the review of the supplement to the PEIS. Government agencies likely to have such potential interests and their involvement in the review process are indicated in Figure 4.1.

In addition to any NEPA reviews, the staff will conduct a safety evaluation. The staff makes a decision regarding significant hazards. If a significant hazard is determined to exist, the public will be given an opportunity for a hearing prior to approval of the proposed action. If the staff determines that there is no significant hazard associated with the proposed amendment to the license, and if the staff recommends approval of the action, then the amendment is issued and the opportunity for a public hearing is provided after issuance of the amendment.

- (2) If the proposed action does not involve the need for a license amendment, the TMIPO first determines if the action is within the scope of the PEIS in a manner similar to (1) above. If it is determined that the major activity and its predicted environmental impacts fall outside the scope of those already assessed in the PEIS, the Commission will be informed and the TMIPO staff will complete necessary reviews in accordance with NEPA and NRC requirements. The TMIPO will then conduct a safety review and recommend approval or disapproval of the action to the Commission.

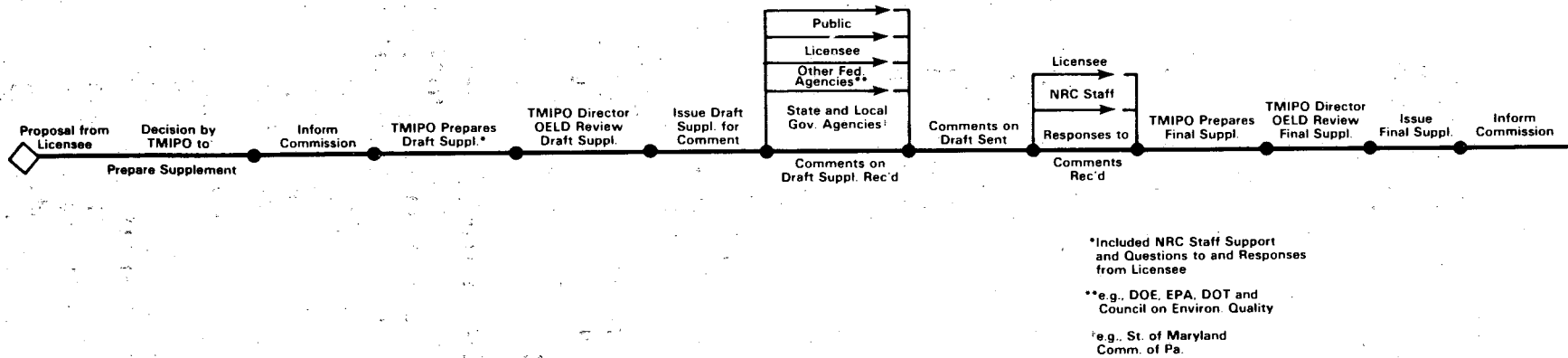


Figure 4.1 NRC Review for TMI-2 Operation Requiring a Supplement to the PEIS

If the action is determined to be within the scope of the PEIS the staff performs a safety and environmental review and informs the Commission of the staff's action on major activities proposed by the licensee.

## 5 THE MASTER SCHEDULE OF MAJOR CLEANUP ACTIONS

Each cleanup operation could be accomplished by a number of alternative methods. A review of generalized alternatives has been presented in the Programmatic Environmental Impact Statement. The alternative chosen for a specific operation will depend, to a large degree, on the specific condition of the facility, the anticipated environmental impact, and the availability of financial resources. Specific information about these conditions will become available only as the cleanup progresses. Depending on the alternatives selected, the type and extent of preparation and support facilities required will vary. For this reason, the anticipated schedule of cleanup actions will only designate the type of operation and support activities, not the methods to be used.

Although there are overlapping cleanup efforts (e.g., the processing of contaminated water is an on-going task), operations, in general, are expected to proceed sequentially according to the milestones shown in Figure 5.1. Also scheduled are a number of major support activities and facilities that are planned to be in place for each milestone prior to those cleanup operations.

Table 5.1 outlines the master schedule of anticipated actions. Due to the present uncertainty of funding past 1984, the estimated times for completion of various activities are presented only for Calendar Year (CY) 1984. The present uncertainty in funding does not allow for time estimates for completion of remaining cleanup activities after CY 1984. The sequence of cleanup activities, however, is anticipated to generally remain the same.

The removal of radwaste from the TMI site is an ongoing activity. With the Memorandum of Understanding between the Department of Energy (DOE) and NRC, it is expected that DOE will be able to take those radwastes needed for generic research and development and those unacceptable for commercial disposal sites. It is assumed that a commercial burial site will continue to be available for disposal of low level radioactive wastes generated throughout the cleanup. Thus, onsite storage of radwastes for significant periods should not be necessary.

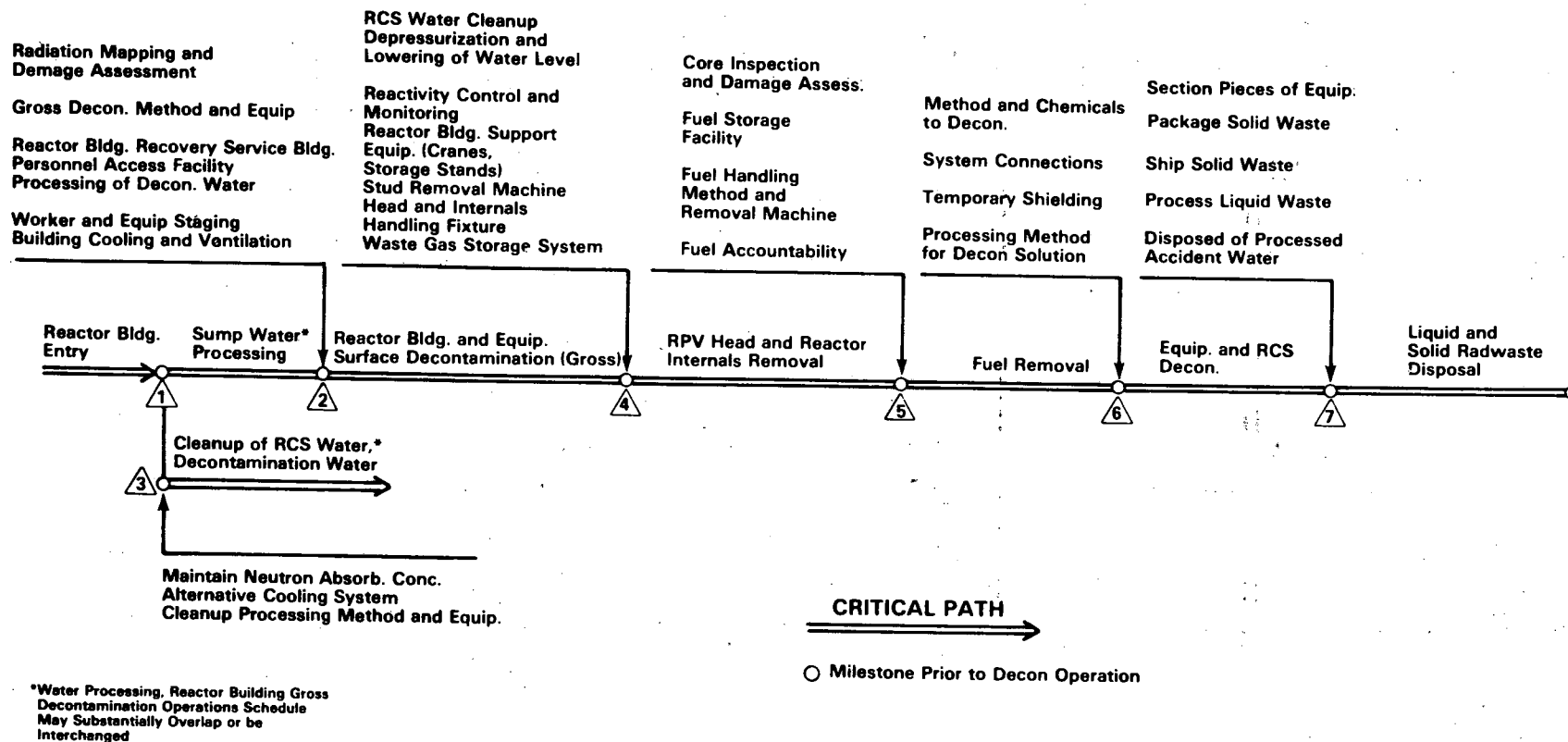


Figure 5.1  
Critical Path and Key Preparations for Cleanup Operations



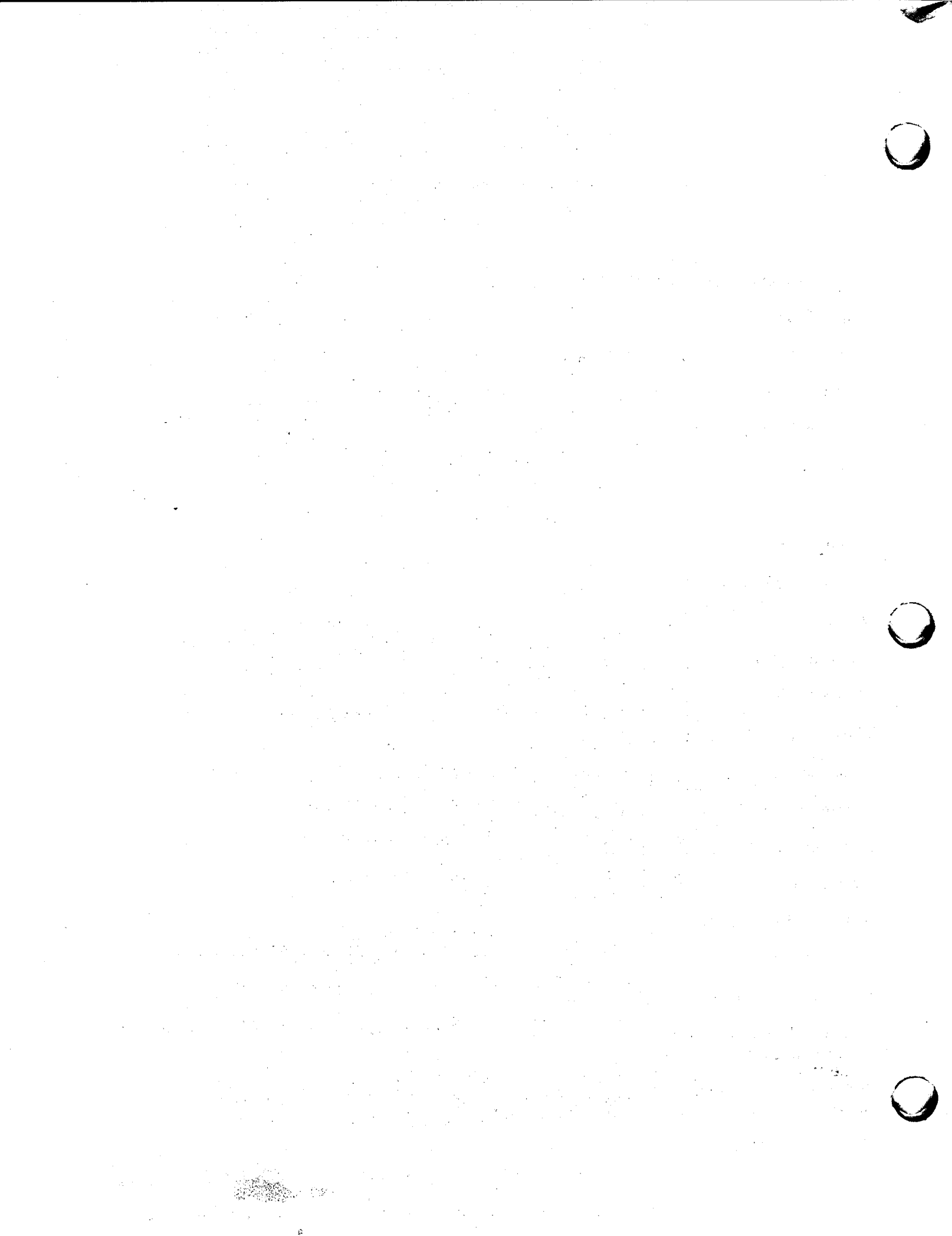
TABLE 5.1

TMI-2 ESTIMATED COMPLETION DATES  
OF SCHEDULED MILESTONES

<u>Milestone</u> <u>Calendar Year 1984</u>	<u>Date</u>
Canal Seal Plate Installation	March 84
Reactor Cooling System Refill and Processing	April 84
Detensioning Reactor Pressure Vessel Head Studs	March/June 84
Reactor Head Removal	August/September 84
Reactor Plenum Inspection	December 84
Purification Demineralizer Disposal Preparation	December 84
<u>Calendar Year 1985 and Beyond*</u>	
Complete Reactor Building Hands-On Decon	Undeterminable
Reactor Plenum Removal	"
Start Reactor Fuel Removal	"
Complete Fuel Removal	"
Leadscrew Removal	"
Start Reactor Coolant System (RCS) Decontamination	"
Complete Core Support Assembly Removal	"
Complete RCS Decontamination	"
Start Reactor Fuel Shipping	"
Complete Fuel Shipping	"
Final Decon	"
Disposal of Processed Accident Water**	"
Complete Radwaste Shipping	"

\*Due to uncertainty of funding estimates of commencement or completion of milestones cannot be made at this time.

\*\*Method of disposal of processed accident water requires Commission approval.



## 6 STATUS OF CLEANUP-RELATED ACTIVITIES

### 6.1 Completed Activities

Three Mile Island Unit 2 (TMI-2) cleanup activities began soon after the accident on March 28, 1979. To date, the following tasks and associated NRC actions have been completed.

#### Issuance of the Final Programmatic Environmental Impact Statement

On March 9, 1981, the Nuclear Regulatory Commission issued a Final Programmatic Environmental Impact Statement (PEIS) (NUREG-0683) related to the decontamination and disposal of radioactive wastes resulting from the accident. In that statement, a wide range of alternatives for decontaminating the TMI-2 facility, defueling the reactor, and disposing of the radioactive wastes were considered and their potential impacts on the environment, members of the public and plant workers were indicated. In conjunction with the issuance of the PEIS, the Commission also issued a Policy Statement in April 1981 which states that the cleanup should be expedited, consistent with maintaining public health and safety. In the Policy Statement, the Commission also outlined the NRC's policy in the review and approval of subsequent cleanup operations.

#### Memorandum of Understanding with the Department of Energy

In July 1981, a Memorandum of Understanding (MOU) concerning the removal and disposition of abnormal solid wastes from the cleanup of TMI-2 was signed by representatives of NRC and the Department of Energy (DOE). This MOU was modified in March 1982 to include disposition of the entire damaged core. As a result of the MOU, DOE has taken the 50 EPCIOR-II first-stage liners for research and development purposes, storage, or disposal. Shipment of the EPICOR-II first-stage liners to Idaho National Engineering Laboratory (INEL) began in August 1982 and was completed in July 1983. As of January 1984 DOE has also taken 15 Submerged Demineralizer System (SDS) liners, with shipments to DOE, Hanford, Washington.

#### Decontamination of the Accident-Generated Water in the Auxiliary and Fuel Handling Building

The decontamination of 570,000 gallons of accident-generated water in the auxiliary and fuel handling building has been completed using the EPICOR-II System. The processing of this waste water resulted in the generation of a number of low-level waste resin liners in addition to the higher activity prefilters discussed above. In March 1981, NRC approved the shipment and disposal of commercial low-level waste consisting of 22 EPICOR-II spent resin liners used in processing this water. By July 1, 1981, all these resin liners had been shipped to the commercial waste disposal site at Hanford, Washington, for final burial. This decontaminated water is being stored onsite and is also being used for other cleanup activities.

## Krypton Venting

Following NRC approval, the licensee purged krypton from the reactor building's atmosphere via a controlled purging method in June-July, 1980. Since that time, numerous entries into the reactor building have been made by the licensee for purposes of data gathering and maintenance work in support of decontamination efforts. Very small releases of krypton have been made (on the order of 10 curies or less) prior to each entry.

## Decontamination of the Accident-Generated Water in the Reactor Building

In September 1981, decontamination of the balance of accident water located in the reactor building sump and reactor coolant system was initiated using SDS, an underwater ion-exchange system. The processing of the accident-generated water was completed in May 1982. SDS is presently used to periodically process reactor coolant system (RCS) water and reactor building sump water resulting from containment building decontamination efforts. As of January 1984, 15 SDS vessels have been shipped to DOE, Hanford, Washington.

## Uncoupling of Leadscrews

The leadscrews to the 61 control rods and 8 axial power-shaping rods have been uncoupled as a necessary prerequisite to removal of the reactor pressure vessel head.

## Remote Examination Inside the Reactor Pressure Vessel

During July and August of 1983, a closed-circuit television inspection of the reactor core (termed the "Quick Look" inspection) was performed. The TV camera was lowered through the reactor pressure vessel head and upper internals at three different locations. When the camera was lowered into the core region, the observers could identify rubble approximately five feet below what was the former top of the core. Preliminary information on the radiation field under the reactor pressure vessel head was also obtained during the Quick Look examination.

During August and September 1983, a second effort was undertaken by the licensee to better characterize conditions inside the reactor pressure vessel. This program was called Underhead Characterization. It included a visual inspection by remote closed circuit television camera of the plenum and the core void area. The licensee also took grab samples of the rubble bed, made a radiological examination of the area under the reactor pressure head, and conducted sonic (sonar) mapping of the core void area. Results from both Quick Look and the Underhead Characterization programs are being used to plan reactor pressure vessel head lift, plenum removal, and defueling.

## Reactor Building Polar Crane Refurbishment and Testing

The polar crane has been refurbished. The load test procedures for the polar crane, needed for removal of the reactor pressure vessel head and plenum removal, were approved by the NRC in November 1983. Load testing of the polar crane was completed in February 1984.

### 6.2 Ongoing Cleanup Activities

Some of the major ongoing activities include the following:

#### Supplement to the PEIS Dealing with Worker Exposure

On January 5, 1984, the NRC issued a draft Supplement to the PEIS dealing with occupational radiation exposure. The Supplement revised upward the anticipated occupational exposure from a range of 2,000 to 8,000 person-rem, estimated in the original PEIS, to 13,000 to 46,000 person-rem. When the original PEIS was prepared, the reactor building had been entered only five times. Since then, it has been entered more than 280 times to collect data, conduct tests, perform decontamination tests and decontamination, refurbish the polar crane, remove trash and contaminated equipment, and begin preparation for fuel removal. This increased knowledge of actual conditions in the building, and the awareness of the penetration of contamination into surfaces and the extent of corrosion, have resulted in higher estimates of occupational exposure.

#### Licensee's Dose Reduction Program

In late 1982 the licensee launched a multi-phase dose reduction program to reduce radiation exposure to workers. This ongoing program includes the shielding of known sources of exposure, such as floor drains, hatches, penetrations, the enclosed stairwell and the elevator shaft. These efforts have resulted in significant reductions in the dose rate in the reactor building.

#### Reactor Building Entries

Entries into the reactor building for purposes of damage assessment, data collection and equipment maintenance began on July 23, 1980, after the reactor building atmosphere had been purged of krypton. By the end of 1983, over 300 entries had been made by the licensee and its contractors. Prior to each entry, the NRC TMIPO onsite staff reviews the planned tasks and radiation protection precautions and closely monitors the activities of each entry. Occupational doses incurred during these reactor building entries continue to be monitored by the TMIPO staff to ensure that radiation doses are kept as low as reasonably achievable (ALARA).

## Auxiliary and Fuel Handling Building (AFHB) Decontamination

In addition to removal and processing of water spilled in the AFHB basement, cleanup of contaminated surfaces and equipment in the AFHB is about 80% complete, with the exception of a number of isolated cubicles. It should be noted, however, that near-term access to these cubicles is not considered vital to reactor safety maintenance or other on-going cleanup efforts in the reactor building.

## Plant Effluents and Waste Disposal

Following issuance of the final PEIS in March 1981, the technical specifications of TMI-2 governing the limits for radioactive material in effluents were amended to incorporate those proposed in Appendix R of the PEIS. The technical specifications now limit the radioactive material releases in gaseous and liquid effluents to those stated as design objectives for operating reactors in Appendix I of 10 CFR Part 50. All cleanup operations thus far have been conducted well within these limits.

Low-level solid wastes (e.g., compacted trash, dewatered resins with radioactivity less than 1 uCi/mL) continue to be shipped to a commercial disposal site for burial.

## "A" Spent Fuel Pool Refurbishment

In September 1983 the NRC approved modification to the "A" spent fuel pool to decommission the tank farm and refurbish the fuel pool. The tank farm was utilized during SDS processing of reactor building sump water. The refurbishment activities are designed to prepare the fuel pool for fuel removal from the TMI-2 reactor core. The licensee's activities are presently on hold pending availability of additional funding.

## Reactor Pressure Vessel Head (RPVH) Stud Detensioning

In September 1983 the licensee submitted a proposal for detensioning the RPVH studs (in preparation for future head removal) and for removal of up to five studs and associated nuts. The staff completed its review of the licensee's proposal and in February 1984 provided approval in principal for this work.

Stud detensioning is normally a routine activity during the reactor pressure vessel head removal sequence. However, at TMI-2 the studs have not been detensioned for a period in excess of five years and may well be stuck due to rust and corrosion of the metal surfaces. Stud detensioning is accomplished by relieving the tension or elongation in each stud in two passes. The detensioning process involves stretching the studs and partially unwinding the nuts in a patterned sequence with a hydraulic detensioning machine. The primary purpose of stud detensioning is to check for stuck nuts and studs so that tooling and procedures can be developed to facilitate future head removal.

Removal of the studs and nuts will permit examination of their condition and provide information necessary for their safe handling and subsequent packaging and disposition. The licensee plans to begin detensioning in mid-1984.

### 6.3 Future Activities Requiring NRC Review and Approval

#### Building and Equipment Surface Decontamination

The purpose of this cleanup activity is to decrease the radiation field within the reactor building so that occupancy-intensive activities, such as hands-on decontamination work related to fuel removal, can be carried out.

Cleanup of the reactor building and equipment will result in an estimated 5,900 to 21,000 person-rem of occupational radiation dose. As much as 80% of this dose is associated with cleanup of the reactor building basement.

Final cleanup of cubicles and systems in the AFHB, including the processing of decontamination waste from system and tank cleanup, is estimated to require between 500 and 1,400 person-rem. Licensee plans for some of these efforts have recently been approved by the TMIP0.

TMIP0 approval of future decontamination proposals will be based on a review of:

- 1) radiation levels from reactor building radiological surveys,
- 2) methods for gross and subsequent manual decontamination that specifies equipment and procedures needed for cleanup operations,
- 3) methods for processing the resulting decontamination liquids and packaging and storing the resultant radioactive wastes,
- 4) the interaction of the proposal and the dose reduction program,
- 5) proposed final conditions for areas to be decontaminated, including plans for final surveys, and
- 6) the safety and environmental consequences of the proposed action.

The draft Supplement to the PEIS dealing with occupational radiological exposure determined that decontamination of the reactor building would be the single most significant contributor to the total occupational exposure during cleanup of TMI-2. Consequently, the NRC staff will closely monitor this decontamination effort and monitor occupational exposures incurred to ensure adherence to the ALARA principal.

## Reactor Pressure Vessel (RPV) Head and Reactor Upper Internals Removal

The licensee's proposal for these activities will be based on prelift examination data and should contain information on methods of RPV head and reactor upper plenum assembly removal. Special consideration will be given to damage from the accident that could possibly hinder removing the RPV head (e.g., distortion, warping, and/or physical dislocation), criticality control, core cooling, reactor coolant cleanup, RCS depressurization and lowering of reactor coolant level. The following items will also be reviewed by the staff regarding these proposed activities:

- (1) the radiation levels expected in the worker occupancy areas,
- (2) total occupational exposure and radiation protection features,
- (3) safety concerns of equipment handling to prevent heavy loads from striking the core after RPV head removal,
- (4) airborne radioactivity control and environmental consequences, and
- (5) detailed procedures for accomplishing this work.

Other support systems, facilities, and equipment requiring NRC reviews include systems to monitor and control the reactivity of core debris, a system for the processing and storage of waste gases from the primary cooling system, facilities for the staging and storage of the RPV head and internals, an RPV head and internals handling fixture, and stud-removal equipment.

## Fuel Removal

The licensee's proposal should contain information on the status of the reactor following the RCS water cleanup and RPV head and reactor upper plenum removal operations, with special attention given to those factors that would affect core examination (e.g., reactor water purity, fuel assembly debris, and radiation levels at the top of the RPV). The staff review would also include the following items with regard to fuel removal activity:

- (1) the proposed core examination objectives and methods;
- (2) condition of the core and methods to prevent recriticality during defueling operations;
- (3) fuel removal methods (including the anticipated condition of the damaged reactor core and proposed procedures to remove the fuel under those conditions);
- (4) methods to retrieve and remove materials that may become detached (e.g., fuel pellets, cladding fragments) during the proposed fuel removal;



- (5) methods of fuel transfer, canning, and storage;
- (6) fission product monitoring and potential for releases;
- (7) the safety and environmental consequences of the proposed action, including estimates of occupational exposures and radiation-protection measures required to maintain these doses ALARA;
- (8) an analysis of the potential consequences of a dropped fuel assembly and/or an accident caused by equipment dropped onto the reactor core;
- (9) the design criteria and technical information about the equipment proposed for the core examination and fuel removal operations, and
- (10) detailed procedures for each phase of the defueling operation.

A number of support systems and special equipment for the proposed actions will require NRC review. These items include equipment for core examination; fuel containers and a storage facility; underwater cutting and grappling equipment; fuel handling and lifting apparatus; a fission-product gas monitoring and processing system; detached material collection and cleanup systems and a water cleanup system. In addition, during this phase of the cleanup operation, the NRC staff will be in close coordination with DOE.

#### Reactor Coolant System (RCS) Decontamination

The licensee's proposal for this operation should contain information on the levels of contamination of, and damage to, the reactor system components that require decontamination or removal. For each of these major components, cleanup methods should be proposed (e.g., drain/flush and chemical decontamination and/or removal). The staff review of the proposal will also include consideration of the following topics:

- (1) the amounts, activity levels, and chemical properties of liquid radwastes to be generated from the proposed action,
- (2) the methods of detecting fuel and fission products,
- (3) the method for processing the liquid radwaste and the expected results,
- (4) radiation protection features and estimates of occupational exposures,
- (5) criteria and information for RCS decontamination, and
- (6) detailed procedures proposed for the operation.

Depending on the condition of the facility and on the proposed method of cleanup, supporting systems for this operation may include the use of the reactor coolant pumps, special equipment for high-pressure flushing of coolant lines, systems to prepare and introduce chemical decontamination solutions, solid radwaste processing systems, and processed decontamination water and solid radwaste storage or staging facilities.

#### Purification Demineralizer Removal

The licensee has committed to the NRC staff that the contents of both 90-cu.-ft. RCS resin demineralizers will be prepared for disposal by the end of 1984. These demineralizers were loaded with significant quantities of fission products (i.e., cesium-137 and strontium-90) and fuel debris during the March 1979 accident. Data is currently being collected to better determine the optimum processing and disposal technique. Preliminary plans for processing will involve a cesium-removal phase and a resin sluicing phase. The licensee will be submitting Safety Evaluation Reports for staff review and approval, for both phases of activities. The cesium-removal phase is scheduled for the fall of 1984 and resin sluicing by the end of the year.

## 7 LICENSEE IMPLEMENTATION OF ACTIONS

The licensee is responsible for maintaining reactor safety and for implementing NRC-approved actions throughout the Three Mile Island Unit 2 (TMI-2) cleanup operation. NRC's responsibility is to ensure that the licensee's actions meet NRC cleanup objectives and that they are implemented according to existing regulations, TMI-2 Operating License and technical specifications, and approved procedures. The NRC is also responsible during the implementation of cleanup actions for coordination with other agencies involved in the cleanup.

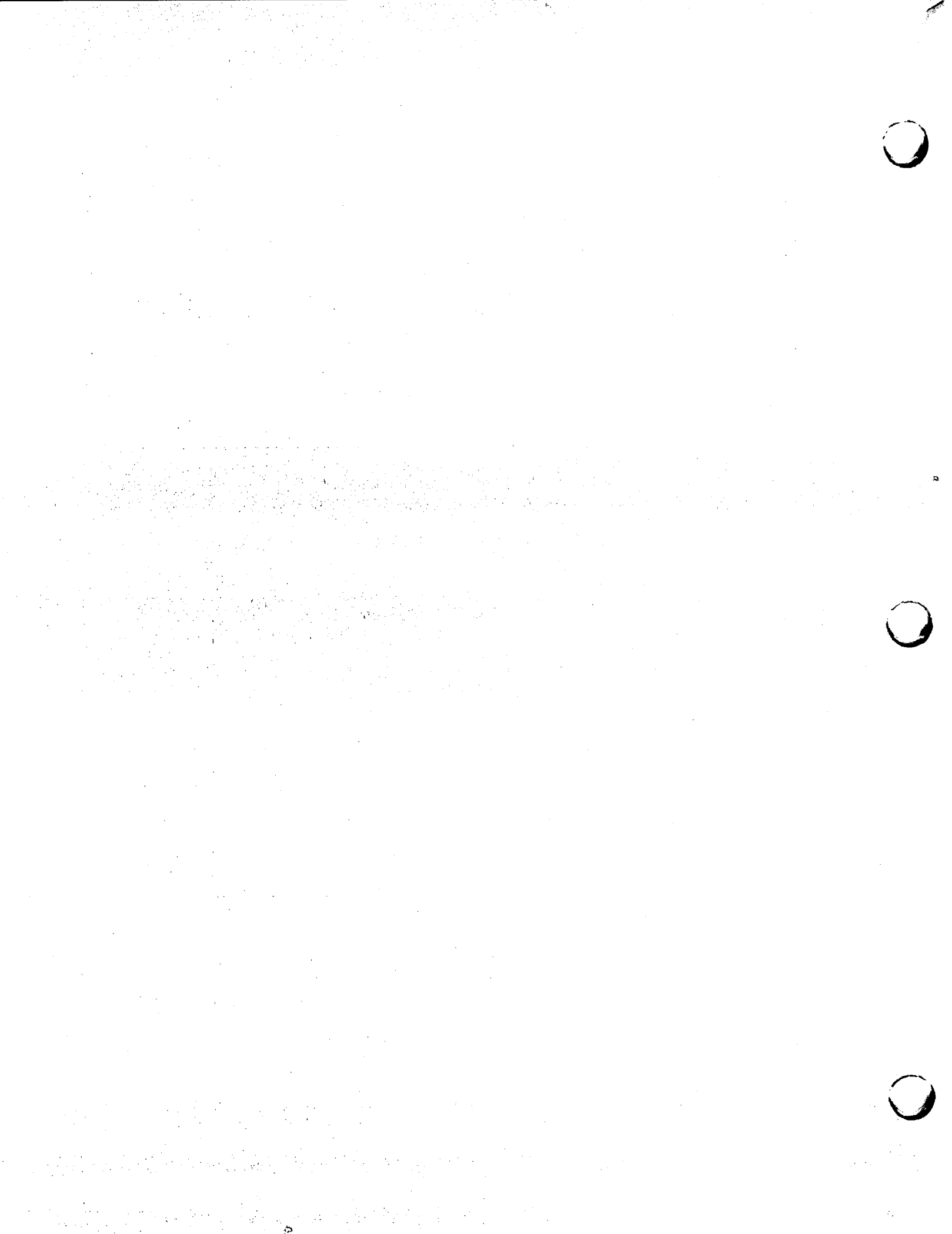
### 7.1 NRC Actions

The NRC, mainly through the onsite TMIP0, will maintain cognizance of the current status of on-going cleanup operations to ensure that they are proceeding according to NRC orders, the facility operating license and technical specifications, and approved procedures.\* The licensee's monitoring data and effluent release reports will be reviewed. Independent monitoring of licensee results will be performed. This information and the progress of cleanup operations will be routinely communicated to government officials and the public, for example, through the issuance of weekly plant status reports.

### 7.2 Other-Agency Actions

Other agencies will participate in cleanup operations. For example, the Environmental Protection Agency (EPA) has the responsibility to monitor the area around Three Mile Island. The Department of Energy (DOE) has proposed a major research and development and data acquisition program in connection with the cleanup to ensure that useful generic information is obtained and disseminated. Pursuant to the July 15, 1981 (revised March 15, 1982) Memorandum of Understanding with NRC, DOE has, as part of its program, agreed to accept radioactive wastes for research and development purposes. Also, the TMIP0 will continue to be in contact with the Pennsylvania Department of Environmental Resources and the Maryland Department of Natural Resources. These and any other activities that may be needed from Federal, State, or local government agencies will be coordinated by the TMIP0.

\*See Section 3.5 for procedures requiring approval.



## 8 REFERENCES

- (1) NUREG-0698, "Potential Impact of Licensee Default on Cleanup of TMI-2," November 1980.
- (2) NUREG-0683, "Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting From March 28, 1979, Accident Three Mile Island Nuclear Station, Unit 2," March 2, 1981.
- (3) NRC Policy Statement on Cleanup of Three Mile Island Plant, April 28, 1981.
- (4) NUREG-0683, Supp. 1, "Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979, Accident Three Mile Island Nuclear Station Unit 2, Draft Supplement Dealing with Occupational Radiation Dose," December 1983.



Appendix A

Memorandum of Understanding  
Between the  
U.S. Nuclear Regulatory Commission  
and the  
U.S. Department of Energy  
Concerning the Removal and Disposition of Solid Nuclear Wastes  
from Cleanup of the Three Mile Island Unit 2 Nuclear Plant

I. Objective

This memorandum of understanding specifies interagency procedures for the removal and disposition of nuclear wastes resulting from cleanup of the Three Mile Island Unit 2 plant. This will help to ensure that the TMI Site does not become a long-term waste disposal facility.

II. NRC Roles and Responsibilities

The NRC has the responsibility under the Atomic Energy Act of 1954 as amended (42 U.S.C. 2011 et seq.), to regulate all licensee activities at the TMI-2 site, including waste management, and ensure these activities are carried out in accordance with the requirements of applicable rules and regulations and the requirements of Facility Operating License Number DPR-73, as modified by amendments or orders issued by the NRC. NRC will carry out its responsibilities by onsite observation of licensee activities. As required, policy, and technical support will be provided to the NRC TMI Site Office by NRC Headquarters and Regional Office(s).

NRC will work cooperatively and closely with the DOE, and will keep DOE fully and currently informed of NRC's activities.

NRC will continue to keep public, state and local officials informed of NRC's activities. When appropriate, NRC will involve DOE in these information exchanges with the public, state and local officials.

### III. DOE Role and Responsibilities

Where DOE determines that generically beneficial research, development and testing of the TMI-2 accident generated solid wastes can be carried out, DOE will perform such activities at appropriate DOE facilities. For those other wastes that cannot be disposed of in commercial low level waste facilities, DOE may also assume responsibility for removal, storage, and disposal to the extent that the licensee provides reimbursement to the DOE. These activities will be undertaken to the extent consistent with appropriate statutory authority. NRC licensing of DOE facilities that are utilized for storage, processing or disposal of TMI-2 accident generated wastes will not be required since these facilities have primary uses other than for receipt and storage of wastes resulting from licensed activities.

The DOE will provide technical support to the licensee and the NRC as deemed appropriate.

DOE will work closely with the NRC and keep NRC informed of DOE's activities.

### IV. Currently Identified TMI-2 Accident Generated Solid Radioactive Wastes

The following lists those TMI-2 accident generated solid radioactive wastes which currently exist or are planned to be generated. This listing may be modified in the future as the cleanup progresses.



1. EPICOR-II System Wastes

Forty-nine ion exchange resin liners with loadings up to 1500 curies/liner are in temporary storage at the TMI-2 site. DOE plans to develop a prototype high integrity container (HIC), production units of which, if utilized by the licensee, may allow these liners to be acceptable for licensed disposal in commercial land burial facilities some 1-2 years from now. DOE is also performing characterization experiments on one of these liners and may find it desirable to extend its R&D program to other liners. Should a more expeditious handling of these wastes be required due to the potential for a limited release to the storage environment (which could cause public concern), a contingency plan will be implemented wherein DOE would at its discretion take receipt of these EPICOR liners on a reimbursable basis from the licensee for storage or disposal. Future EPICOR-II liners are anticipated to be loaded to allow commercial shallow land disposal offsite by the licensee.

2. Submerged Demineralizer System Wastes

It is anticipated that the dispersed radioactivity in accident generated water will be deposited on zeolites in submerged demineralizer system (SDS) liners. Due to the unique character and nature of these wastes, DOE will take possession of and retain these liners to conduct a waste immobilization research and development and testing program.

### 3. Reactor Fuel

Following removal of the damaged core from the reactor vessel, the entire core will be shipped to a DOE facility to survey and select those portions most appropriate for DOE's R&D program. Information obtained from detailed examinations is expected to be of generic benefit to design, fabrication and operation of reactor cores in a safe and efficient manner for current and future nuclear power plants. The remainder of the core will remain in storage at the DOE facility and will be ultimately disposed of under an agreement to be negotiated between DOE and the owner.

### 4. Transuranic Contaminated Waste Materials

As the cleanup progresses, some waste materials (e.g., sludges) may be found to be contaminated with transuranics at levels above which commercial low level burial facilities are authorized to accept. Alternatives for such material will be considered on a case-by-case basis and could include archiving, R&D evaluation or temporary storage onsite, or at a DOE facility awaiting further processing and/or disposal in a permanent repository offsite. Depending on the nature of these materials, DOE's activities could either take the form of an R&D program of generic value, or would be subject to reimbursement by the licensee.

### 5. Makeup and Purification System Resins and Filters

During the TMI-2 accident, the makeup and purification system demineralizer vessels and filters were highly contaminated by letdown

of reactor coolant through the system. These resins and filters have not been characterized, however, based on radiation measurements, the resins and filters are believed to have specific activities well in excess of the loadings on the high specific activity EPICOR-II prefilters and are considered unsuitable for commercial land disposal. Due to the generic value of the information to be obtained and the very high specific activities of the filters, DOE will take possession and retain these filters for research and development activities. DOE will also take possession of and retain purification system resins either for an R&D program of generic value or for storage or disposal on a reimbursable basis.


6. Other Solid Radioactive Wastes


The low-level wastes associated with decontamination (e.g., some ion exchange media, booties, gloves, trash) will be disposed of by the licensee in licensed commercial low level burial facilities.

- V. This Memorandum of Understanding will take effect when it has been signed by the authorized representative indicated below for each agency. DOE and NRC shall each have the right with the consent of the other party to modify this agreement.

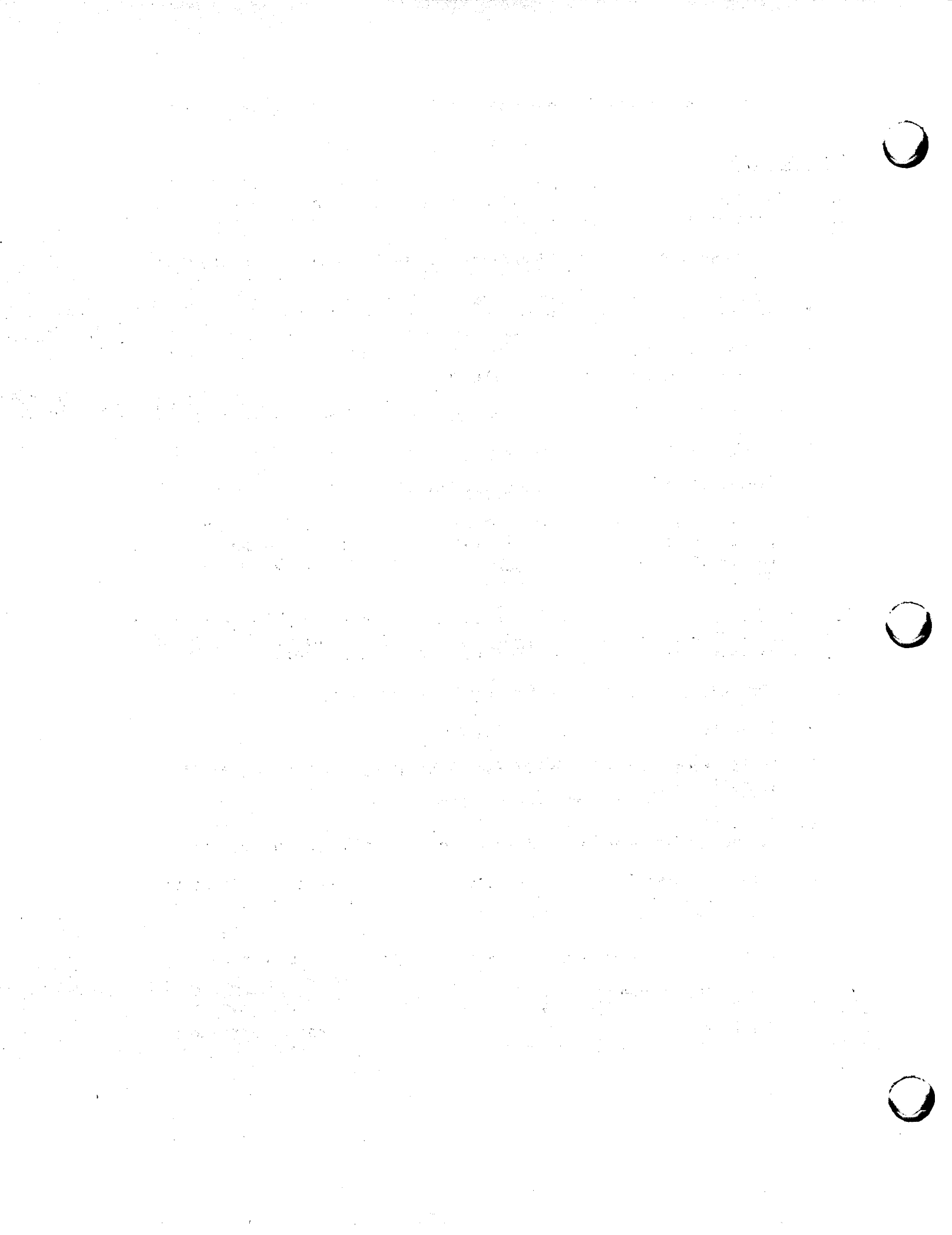
FOR THE U.S. NUCLEAR REGULATORY COMMISSION

FOR THE U.S. DEPARTMENT OF ENERGY

  
 Bernard J. Snyder, Program Director  
 TMI Program Office  
 Office of Nuclear Reactor Regulations

  
 Franklin E. Coffman  
 Deputy Assistant Secretary for  
 Nuclear Waste Management and  
 Fuel Cycle Programs  
 Office of Nuclear Energy  
 Date: 3/15/82

Date: 3/15/82



## Appendix B

### TMI-2 Technical Specification on Written Procedures

#### 6.8 PROCEDURES

6.8.1 Written procedures shall be established, implemented and maintained covering the activities referenced below:

- a. The applicable procedures recommended in Appendix "A" of Regulatory Guide 1.33, Revision 2, February 1978.
- b. Recovery Operations Plan implementation.
- c. Surveillance and test activities of safety-related equipment and radioactive waste management equipment.
- d. Security Plan implementation.
- e. Emergency Plan implementation.
- f. Radiation Protection Plan implementation.
- g. Limiting the amount of overtime worked by plant staff members performing safety-related functions in accordance with the NRC policy statement on working hours as transmitted by Generic Letter 82-12.

6.8.2.1 Each procedure and any change to any procedure prepared pursuant to 6.8.1, shall be prepared, reviewed and approved in accordance with 6.5 and will be reviewed periodically as required by ANSI 18.7 - 1976.

6.8.2.2 Procedures of 6.8.1.a and changes thereto which:

- a. Directly relate to core cooling, or
- b. Could cause the magnitude of radiological releases to exceed limits established by the NRC, or
- c. Could increase the likelihood of failures in systems important to nuclear safety and radioactive waste processing or storage, or
- d. Alter the distribution or processing of significant quantities of stored radioactivity or radioactivity being released through known flow paths.

Shall be subject to approval by the NRC prior to implementation.

6.8.3.1 Temporary changes to procedures of 6.8.1 may be made provided if:

- a. The intent of the original procedure control is not altered, and

- b. (1) For those procedures which affect the operational status of unit systems or equipment, the change is approved by two members of the unit management staff, at least one of whom holds a Senior Reactor Operator's License. If one of the two above signatures is not by a supervisory person within the Department having cognizance of the procedure being changed, the signature will also be required, or  
  
(2) For those procedures which do not affect the operational status of unit systems or equipment the change is approved by two members of the responsible organization. If one of the two above signatures is not be a section manager/director within the Department having cognizance of the procedure being changed, this signature will also be required, and
- c. The change is documented, Independent Safety Review completed, and the required reviews and approvals are obtained within 14 days, and
- d. Those changes to procedures described by 6.8.2.2 are submitted to the NRC for review within 72 hours following approval by the management level specified for implementation by Section 6.5.1.9.

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13. SUPPLEMENTARY NOTES

14. ABSTRACT (200 words or less)

This report updates a plan that defines NRC's role in cleanup operations at Three Mile Island Unit 2 (TMI-2) and outlines NRC's regulatory responsibilities in fulfilling this role.

Since the initial issuance of this NRC Plan in July 1980, this office has issued the Final NRC Programmatic Environmental Impact Statement (PEIS) related to the entire TMI-2 cleanup and a draft Supplement to the PEIS related to occupational radiation exposure. Additionally, a number of developments have occurred which will have an impact on the course of cleanup operations. This revision provides a discussion of these developments, specifically in the areas of the functional role of the NRC in cleanup operations, the cleanup schedule, and the current status of the cleanup. The plan also discusses NRC's perceived role in future cleanup activities. Because of major uncertainties in the funding of the cleanup, portions of this plan, including the estimated schedule, are likely to require further changes as availability of funding and other factors affect the pace of the cleanup.

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